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# Black mildew fungi (*Meliolaceae*) associated with *Schinus terebinthifolius* (Brazilian pepper tree) in Brazil

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**Abstract** —*Meliola chilensis, M. rhois* var. *africana,* and *Irenopsis schini-terebinthifolii* sp. nov. are described from the leaves of *Schinus terebinthifolius* (*Anacardiaceae*). Illustrations and a key to all *Meliolaceae* known to associate with species belonging to the genus *Schinus* are provided.

**Key words** — *Ascomycetes*, Atlantic forest, biodiversity, taxonomy, tropical fungi

## Introduction

*Schinus terebinthifolius* Raddi (*Anacardiaceae*), the Brazilian pepper tree (known in Brazil as "aroeira"), is a small sized plant widely distributed in Brazil, Argentina, and Paraguay. Introduced to many other tropical and sub-tropical regions as an ornamental or spice source, the Brazilian pepper has invaded natural ecosystems and provoked serious disruptions of such natural areas. Now regarded as one of the worst invasive plant species in Florida, Hawaii, and New Zealand (Ferriter 1997), for several decades it has been a target of biological control programs by using insects as its natural enemies (Cuda et al. 2006).

Surveys of and research on fungal pathogens of *S. terebinthifolius* have been only recently initiated in Brazil. A partial result of such surveys published by Faria et al. (2008) has revealed a significant diversity of pathogenic or purported pathogenic fungi associating with *S. terebinthifolius*. Some of these, such as *Septoria* sp., have clear potential for use in biological control of the

Brazilian pepper tree (Faria et al. 2008). The present publication deals with a group of species in the fungal family *Meliolaceae* collected on *S. terebinthifolius*. Although they clearly show no potential for biocontrol, they do represent mycological novelties.

The *Meliolaceae* includes approximately 1980 species, of which most are from the tropics (Kirk 2008). The main genera in this family are *Amazonia* Theiss., *Appendiculella* Höhn., *Asteridiella* McAlpine, *Irenopsis* F. Stevens, and *Meliola* Fr. (Hansford 1961). Meliolaceous fungi produce black colonies on the host surface and hence are known as black mildews. They have little economic importance even when attacking cultivated plants since the disease severity is generally low (Sabulal et al. 2006, Hosagoudar et al. 1997). In some cases, particularly when the host-species is an ornamental plant and black mildew colonies are abundant on it, this may harm the appearance of the plant as reported for *Asteridiella pittieri* (Toro) Hansf. attacking *Duranta repens* L. (Pereira et al. 2006).

Three distinct black mildew taxa were found during the survey of the mycobiota on *S. terebinthifolius*. Even not useful for biocontrol, their potential as scientific novelties justified further investigation. There is an obvious need to broaden the knowledge of the *Meliolaceae* in Brazil, as the group has been largely neglected by Brazilian mycologists and little has been published on this fungal group in Brazil in contrast to the large number of novel taxa in the *Meliolaceae* described from other tropical countries (Crane & Jones 2001, Hosagoudar & Shiburaj 2002, Song & Li 2004, Biju et al. 2005, Rodriguez & Piepenbring 2007).

## Materials and methods

The mycobiota on *S. terebinthifolius* was intensively surveyed during two different periods from September 2001 to May 2003, concentrated at first in a small part of southeastern Brazil in areas of the states of Rio de Janeiro, São Paulo, and Minas Gerais and later expanding to include also Espírito Santo, Paraná, Santa Catarina, and Rio Grande do Sul and additional ad hoc collections in the state of Pernambuco from 2008 to 2010. Foliage of *S. terebinthifolius* bearing black mildew colonies was collected, observed while still fresh, and then dried in a plant press. Samples were examined under an Olympus SZX7 stereomicroscope. Representative structures were either scraped with a scalpel or removed with an adhesive tape and mounted in lactophenol. Fungal structures were measured, photographed, and drawn using an Olympus BX 51 light microscope equipped with an Olympus e-volt 330 digital camera and a drawing tube. Representative specimens were deposited in the local herbarium at the Universidade Federal de Viçosa (Herbarium VIC).

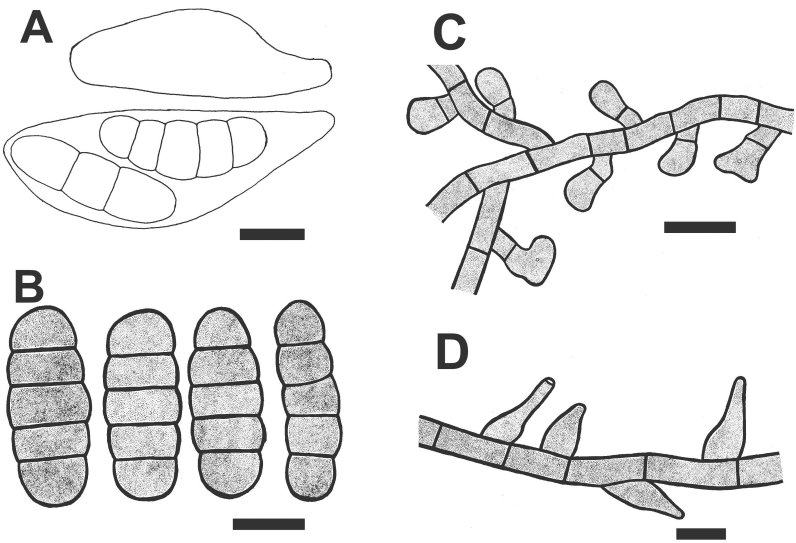


Plate 1. *Meliola chilensis*. A. Asci and immature ascospores. B. Ascospores. (Bar = 20μm). C. Appressoria on hypha. D. Conidiogenous cells on hypha. (Bar = 20μm).

## Taxonomy

***Meliola chilensis*** Speg., Bol. Acad. Nac. Ci. 25: 41 (1921) Plate 1

Specimens examinated: on leaves of *Schinus terebinthifolius,* **BRAZIL, Minas Gerais,** Heliodora, 08 July 2008, D.M. Macedo (VIC 31323); São Brás do Suaçuí, 28 October 2009, D.M. Macedo (VIC 31336); Barbacena, 28 October 2009, D.M. Macedo (VIC 31337); **Paraná,** Bacaetava, 09 July 2008, D.M. Macedo (VIC 31322).

Colonies amphigenous, mostly epiphyllous, black, dense, subvelvety, 0.6–2.7 mm diam. Hyphae crooked, composed of dark brown septate hyphae, cells 15–26.5 × 7.5–9 μm, branching alternate to irregular at acute to irregular angles, producing appressoria and conidiogenous cells. Appressoria alternate, sub-antrorse, straight to bent; stalk cells cylindrical to cuneate, brown, 7.5–10 × 7.5–9 μm; head cell cylindric-clavate, straight to bent, entire, sometimes rounded-angulose to sublobate, brown or reddish brown, 14–20 × 13–19 μm. Conidiogenous cells (phialides) borne on a separate mycelia branch, opposite to alternate, ampulliform, brown, 11–15 × 5–7 μm. Mycelial setae numerous, scattered, straight to slightly flexuous, 7–12 septate, simple, apex obtuse, dark brown, 332–550 × 7.5–10 μm. Perithecia in a central group, black, globose, verrucose, 213–345 μm diam. Asci evanescent. Ascospores oblong, hyaline

when inside the ascus, becoming brown with age, rounded at the tips, 4-septate, constricted at the septa, dark brown, 46–52 × 15–20 μm.

Additional description: Hansford (1961: 470).

Brazilian distribution: Paraná and Minas Gerais (Brazil).

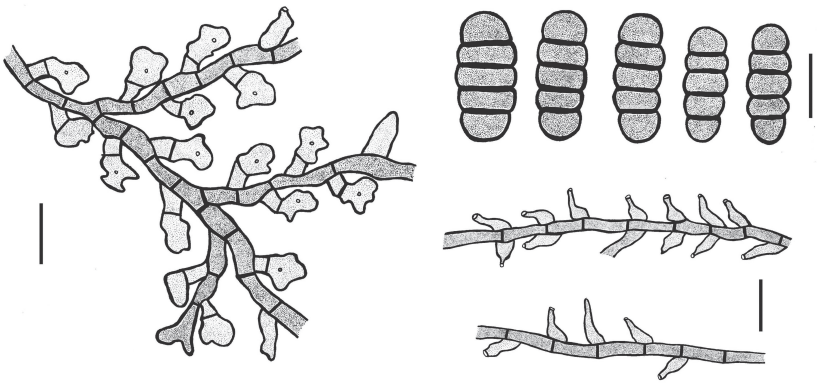

Plate 2. *Meliola rhois* var. *africana*. A. Ascospores (Bar = 20μm). B. Appressoria on hypha (Bar = 20 μm). C. Conidiogenous cells on hyphae (Bar = 30μm).

***Meliola rhois*** var. ***africana*** Hansf., Sydowia 9: 75, 1955 Plate 2

Specimen examined: on living leaves of *Schinus terebinthifolius*, **BRAZIL, Rio de Janeiro,** Mury, 11 April 2008, D.M. Macedo (VIC 31320).

Colonies amphigenous, mostly epiphyllous, black, dense, velvety, cells 3–26 mm diam. Hyphae almost straight to sinuous, composed of dark brown septate hyphae, cells 12.5–25 × 7.5–9 μm, branching usually alternate at acute angles, producing appressoria and conidiogenous cells. Appressoria alternate, more or less antrorse, straight or bent; stalk cells cylindrical to cuneate, brown, 6–10 × 6–7.5 μm, head cell irregularly lobate, versiform, from elongate-clavate to broader than long, straight to variously bent, brown, 12.5–22.5 × 12.5–17.5 μm. Conidiogenous cells (phialides) separate, opposite to alternate, ampulliform, brown, 17.5–25 × 7.5–9 μm. Mycelial setae numerous, scattered, straight, 6–12 septate, simple, apex acute, dark brown, 314–527 × 8.5–10 μm. Perithecia in a central group, black, globose, verrucose, 243–354 μm diam. Asci evanescent. Ascospores oblong to subellipsoid, hyaline when inside the ascus, becoming brown with age, rounded at the tips, 4 septate, constricted at the septa, dark brown, 45–52.5 × 14–19 μm.

Additional description: Hansford (1961: 469).

Brazilian distribution: Rio de Janeiro

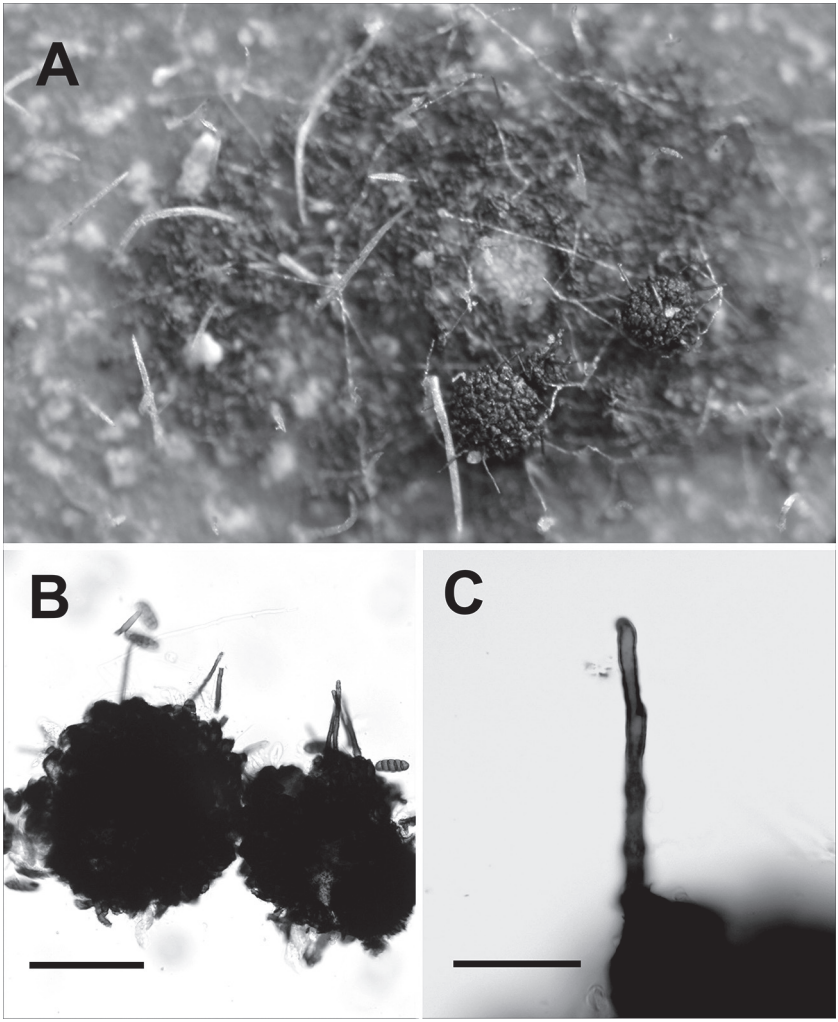


Plate 3. *Irenopsis schini-terebinthifolii.* Plate 3. A. Colony on leaf of *Schinus terebinthifolius.* B. Setose perithecia. C. Close-up of perithecial seta. (Bar = 25 μm).

***Irenopsis schini-terebinthifolii*** D.M. Macedo & R.W. Barreto, **sp. nov.**

MycoBank 18069 Plates 3–4

*Differt a* I. comocladiae *coloniae 0.4–2.1 cm; cellulae hyphales 15–40 × 7–9 μm. cellulae basalis appressoriis 6–11 × 6–10 μm; cellulae apicalis 12–19 × 11–16 μm. Cellulae conidiogenae oppositae, 19–21 × 6–8 μm. Perithecia 168–300 μm diam; setae peritheciales, 1–2 septatae, 64–140 × 5–7 μm; Ascosporae 40–50 × 15–23 μm.*

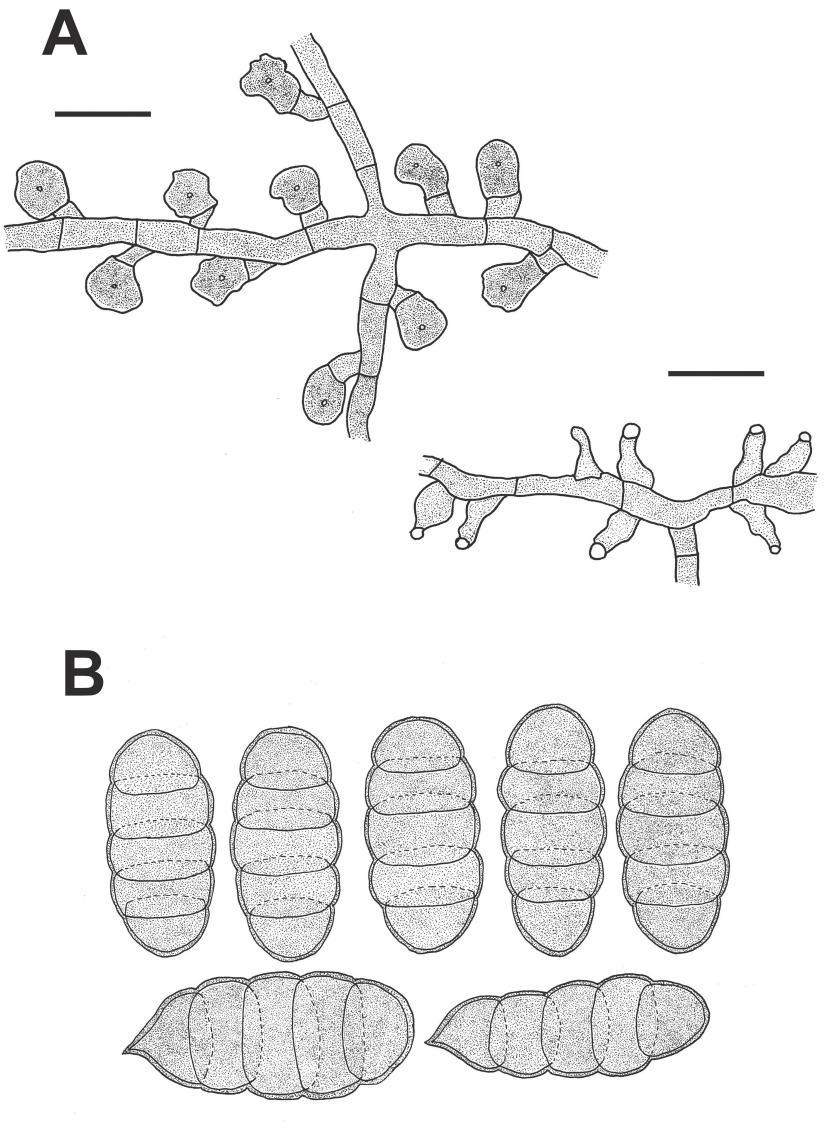


Plate 4. *Irenopsis schini-terebinthifolii.* Plate 4. A. Appressoria and conidiogenous cells on hyphae (Bar= 20 µm). B. Ascospores (note two spores bearing pointed cells on left (Bar = 45 µm).

Type: on living leaves *Schinus terebinthifolius* (*Anacardiaceae*), D. M. Macedo, Casimiro de Abreu, Rio de Janeiro, Brasil (**holotype** - VIC 31318).

Etymology: The epithet refers to the host plant, *Schinus terebinthifolius*

Colonies amphigenous, mostly hypophyllous, confluent, black, dense, scattered, cells 0.4–2.1 mm diam. Hyphae straight, almost straight to undulate, composed of dark brown septate hyphae, cells 15–40 × 7–9 μm, branching opposite at acute or wide angles, producing appressoria and conidiogenous cells. Appressoria alternate, antrorse, bent, 18–30 μm long; stalk cells cylindrical to cuneate, brown, 6–11 × 6–10 μm, head cell irregular, entire to rounded-angulose, brown to reddish brown, 12–19 × 11–16 μm. Conidiogenous cells (phialides) mixed with appressoria, opposite, conoid to ampulliform, brown, 19–21 × 6–8 μm. Perithecial setae straight, 1–2 septate, simple, apex obtuse, dark brown, 64–140 × 5–7 μm. Perithecia black, scattered, globose, 168–300 μm diam. Asci evanescent. Ascospores oblong to subellipsoid, end cells often pointed at apex, hyaline when inside the ascus, becoming brown with age, rounded at the tips, 4-septate, constricted at the septa, dark brown, 40–50 × 15–23 μm.

Distribution: Rio de Janeiro and Minas Gerais (Brazil).

Additional specimens examined: on living leaves of *Schinus terebinthifolius,* **BRAZIL, Rio de Janeiro,** parque Nacional de Jurubatiba, 9 April 2008, D.M. Macedo (VIC 31319); Casimiro de Abreu, 11 April 2009, D.M. Macedo (VIC 31321); **Minas Gerais,** Ponte Nova, 22 August 2008, D.M. Macedo (VIC 31325); Padre Viegas, 22 August 2008, D.M. Macedo (VIC 31326); Catas Altas, 24 August 2008, D.M. Macedo (VIC 31226); Antonio Pereira, 23 August 2008, D.M. Macedo (VIC 31340); Lambari, 23 March 2009, D.M. Macedo (VIC 31334).

Comments – The three meliolaceous fungi collected on *S. terebinthifolius* clearly belong to *Irenopsis* and *Meliola*. The latter is easily separated from *Appendiculella*, *Asteridiella,* and *Irenopsis* by mycelial setae; *Asteridiella* has no setae, *Appendiculella* has perithecia bearing larviform appendages, and *Irenopsis* has setose perithecia (Hansford, 1961).

Forty-two species and 7 infraspecific taxa of *Meliolaceae* are known on members of *Anacardiaceae*. Of these, 38 species and 7 infraspecific taxa belong to *Meliola* (Hansford 1961, Hosagoudar 1996, Hosagoudar & Archana 2009). The following *Meliolaceae* taxa have been reported in association with members of *Schinus*: *Meliola chilensis*, *M. lanigera* Speg., *M. rhoina* Doidge, *M. rhoina* var. *schini* Hansf., *M. rhois* var. *africana* and *M. rhois* var. *lithraeae* Hansf. (Hansford 1961, Mafia et al. 2004, Farr & Rossman 2010, Mendes & Urben 2010). With the exception of *M. chilensis*, all have been reported from Brazil, but only *M. lanigera* was reported in association with *S. terebinthifolius.*

The first fungus described above fits well within the description of *M. chilensis*, a fungus originally known on *Schinus latifolius* (Gillies ex Lindl.) Engl. and *Schinus latifolius* var. *tomentosus* Fenzl from Chile. The second fungus clearly belongs to *M. rhois* var. *africana,* which has been reported on *Rhus glaucescens*

A. Rich. in Uganda and Congo, on *Protorhus longifolia* (Bernh.) Engl. in South Africa, on *Schinus dependens* Ortega in Brazil, and on *Schinus molle* L. in Argentina, Brazil, and Paraguay. Therefore, the two *Meliola* taxa described above represent first reports on *S. terebinthifolius*. There are often more than one species of black mildew associated with plants in the *Anacardiaceae*. For instance, *S. latifolius* is a host for both *M. chilensis* and *M. rhoina* var. *schini,* while *S. dependens* serves as host for *M. lanigera*, *M. rhoina,* and *M. rhois* var. *africana* (Hansford, 1961).

Only two *Irenopsis* species have been described on members of the *Anacardiaceae*: *I. comocladiae* (F. Stevens) F. Stevens and *I. portoricensis* F. Stevens (Hansford 1961, Farr & Rossman 2010, Mendes & Urben 2010). The new specimen referred to *S. terebinthifolius* is the first time an *Irenopsis* species has been reported on a member of the genus *Schinus. Irenopsis schini-terebinthifolii* is distinguished from *I. comocladiae* and *I. portoricensis* by its simple and straight perithecial setae, longer cells at the appressoria bases and larger ascospores.

**Key to *Meliolaceae* taxa associated with *Schinus* spp.**

1. Mycelium not setose ..... *Irenopsis schini-terebinthifolii*
1'. Mycelium setose ..... 2
2. Perithecia dispersed over colony ..... *Meliola rhois* var. *lithraeae*
2'. Perithecia in a central group on colony ..... 3
3. Setae grouped around perithecia ..... *M. rhoina* var. *schini*
3'. Setae scattered over colony ..... 4
4. Setae broadly arcuate to flexuous ..... *M. lanigera*
4'. Setae straight ..... 5
5. Appressoria cylindrical-clavate. ..... *M. chilensis*
5'. Appressoria otherwise ..... 6
6. Ascospores 33–45 × 14–18 µm ..... *M. rhoina*
6'. Ascospores 45–50 × 20–22 µm ..... *M. rhois* var. *africana*

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